A Quick Guide to Pesticides

Use and Regulation in B.C. Forest Management

August 1987

Ministry of Forests and Lands

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Foreword

This Field Guide summarizes a wide range of information about the use of pesticides in B.C. forests. It was assembled to assist field staff and contractors in explaining forest pesticide use to the general public – area residents, special interest groups, local associations, community leaders, officials and occasional bystanders. Because discussions and questions about pest management practices often arise near the treatment site, the field guide format was chosen. It presents information concisely in charts, graphs and diagrams.

The Guide was created as part of the Public Information Strategy on Forest Issues endorsed by the Ministry of Forests in February, 1986. It has received support and input from the Forest Pest Review Committee whose members represent B.C.'s universities, technical schools, forest industry, forest associations, the Environmental Protection Service, and the B.C. Ministries of Health, Environment and Parks, and Forests and Lands.

Information included in this Guide is based on the most recent, authoritative references on pesticides. These references are available to the public in Information Centres at all Forest Service Regional and District offices.

Suggestions and concerns regarding future revisions or the general utility of this guide should be sent to the Director, Public Affairs Branch, B.C. Forest Service, Ministry of Forests and Lands, 4000 Seymour St., Victoria, B.C. V8X 4S8.

1.1 Pesticide Legislation

More than 100 laws in Canada have some authority over the use of pesticides.
Legislation of primary importance:

PROVINCIAL	FEDERAL
Pesticide Control Act – handling, storage and selling **Environment Management Act** – appeals of pesticide use **Forest Act** – right of Ministry of Forests and Lands to control pests, not necessarily with pesticides **Weed Control Act** – right to control noxious weeds, not necessarily with pesticides **Wildlife Act** – protection of wildlife Other Provincial Legislation: **Plant Quarantine Act** **Pesticides Residue Compensation Act** **Plant Protection Act** plus by-laws in several B.C. Districts, towns and cities	**Pest Control Products Act** – registration and availability **Migratory Birds Convention Act** – protection of migratory birds **Fisheries Act** – protection of fisheries **Transportation of Dangerous Goods Act** – storage and transportation **Food and Drugs Act** – pesticide use on livestock forage

References

Forest Pesticide Handbook of British Columbia. 1985. Second Edition. Revised by J.F. Henigman and J.D. Beardsley, Council of Forest Industries of British Columbia. Province of British Columbia, Ministry of Forests.
Copies of Provincial Acts are available from the Queen's Printer for British Columbia, 563 Superior Street, Victoria, B.C. V8V 4R6

Copies of Federal Acts are available from:

Victoria:
Camosun College Bookstore
1950 Lansdowne Road
Victoria, B.C.
V8P 5J2

University of Victoria Bookstore
Box 2200 Finnerty Road
Victoria, B.C.
V8W 1L3

Vancouver:
Worldwide Books and Maps
949 Granville Street
Vancouver, B.C.
V6Z 1L3

1.1 Pesticide Legislation

PROVINCIAL	FEDERAL
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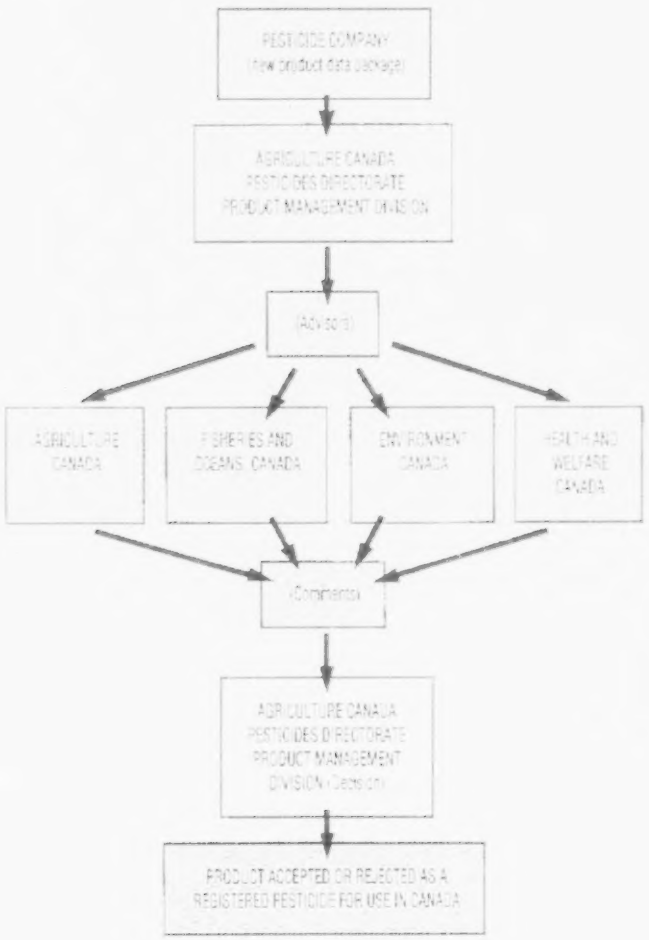
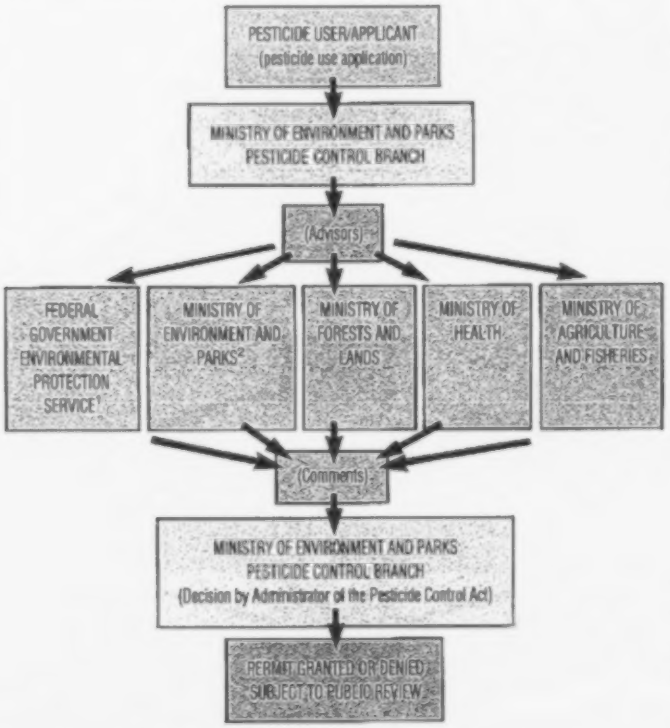
1.2 Federal Pesticide Registration System



1.3 Provincial Pesticide Permit System



[1]Environmental Protection Service acts on behalf of the Dept. of Fisheries and Oceans.

[2]Several Branches of this Ministry are involved in reviewing pesticide use applications (i.e., Wildlife Branch, Recreational Fisheries Branch, Water Management Branch and regional representatives of the Pesticide Control Branch). Environmental Protection Service acts on behalf of the Dept. of Fisheries and Oceans.

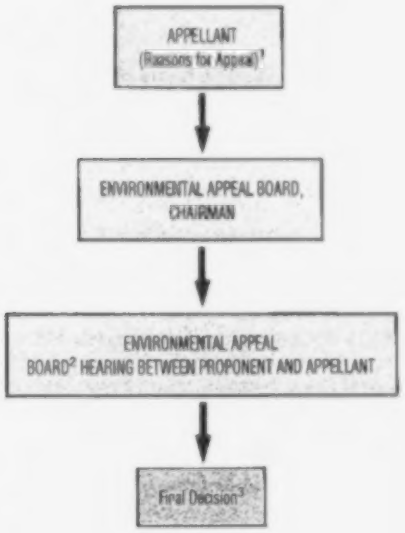
References

Pesticide Use and Control in Canada, 1984. Agriculture Canada, Fisheries and Oceans Canada, Health and Welfare Canada Part I – Regulatory Aspects. EPA, Ottawa, Ontario.

Registration Guidelines. Guidelines for Registering Pesticide and Other Control Products under the Pest Control Products Act in Canada, 1984. Pesticides Division, Agriculture Canada. Ottawa, Ontario.

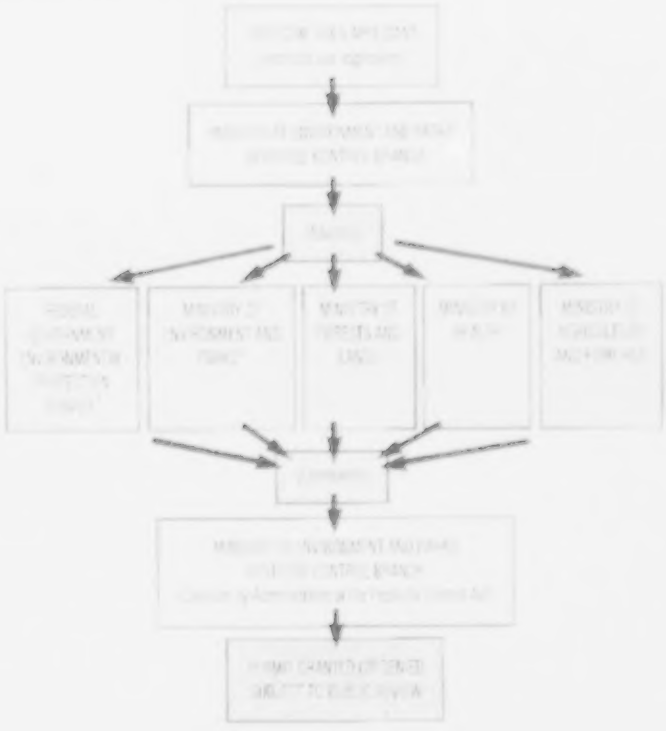
Forest Pesticide Handbook of British Columbia, Second Edition, 1985. Revised by J.F. Henigman and J.D. Beardsley. Council of Forest Industries of British Columbia and B.C. Ministry of Forests, Vancouver, B.C.

1.3 Provincial Pesticide Use Permit Appeal System



[1] The appeal period is within 30 days after the effective date of a permit. All conditions of a permit may be appealed.
[2] Comprised of a chairman and other members as determined by the Lieutenant Governor in Council. Members of the Board are private citizens.
[3] The decision shall support, amend or cancel the permit.

1.3 Provincial Pesticide Permit System



1.3 Provincial Pesticide Use Permit Appeal System

1.3 B.C. Environmental Appeal Board Procedures

Hearing Procedure: Pesticide Permit Appeal

The Permit Holder will defend the permit and the conditions of the permit. The Administrator of the Pesticide Control Act and his staff will not normally attend the hearings.

Procedure

1. The Chairman of the Board or Panel Chairman will open the proceedings by identifying the Board members and the official recorder (the official recorder will be sworn in at this time).

2. The Chairman of the Board or Panel Chairman will then state the authority which allows the Environmental Appeal Board to hear the appeal.

3. The Chairman of the Board or Panel Chairman will then identify the permit which is under appeal, name the permit holder, state the type of pesticide for which the permit has been made and the method and the place of application.

4. The Chairman of the Board or Panel Chairman will then identify the registered appellants, who will then stand and be acknowledged. The registered appellants will then introduce their spokesman and witnesses, if any. All individuals who are to give testimony on the appellants' behalf will then come forward and be sworn in.

5. The Chairman of the Board or Panel Chairman will now call on the Permit Holder's representatives to identify their spokesman and introduce themselves and their witnesses, if any. All individuals who are to give testimony on the permit holder's behalf will then come forward and be sworn in.

6. If there are any representatives of the Administrator of the Pesticide Control Act in attendance at the hearing, the Chairman of the Board or Panel Chairman, will then ask those representatives to stand and identify themselves. All individuals who are representatives of the Administrator and who intend to give evidence before the board, will then come forward and be sworn in.

7. The Chairman of the Board or Panel Chairman will then state the question before the board. The Chairman of the Board or Panel Chairman will then make a statement as to the scope of evidence which will be acceptable and any other limitations of this nature.

9. The Chairman of the Board or Panel Chairman will then review the procedures which will apply at the hearing in connection with giving evidence, cross-examination and summation of the evidence.

9. Each appellant and his witness if any, will now give their testimony and be cross-examined by the permit holder and the members of the Board. Cross-examination of each appellant shall take place before passing on to the next appellant.

10. The permit holder will now give his presentation and be cross-examined by the appellants and the members of the Board.

11. If the representatives of the Administrator of the Pesticide Control Act are to give a presentation, they will do so now, and will be subject to cross-examination by the appellants, the permit holder and the members of the Board.

12. After the questioning of the Appellants, Permit Holder and representatives of the Administrator of the Pesticide Control Act has taken place by the members of the Board or Panel, both the Appellants and the Permit Holder will have the opportunity to re-examine, but only on those matters which have arisen out of the Board or Panel's questions.

13. At the conclusion of all the testimony and cross-examination of all the parties to the appeal, the Permit Holder will then give a summation of his argument, immediately followed by the summation arguments of the Appellants.

14. The appeal will then be concluded. The Board or Panel will reserve its decision.

The Appeal Board considers the following questions:

a. Was the Administrator correct in determining that the damage to man or the environment caused by the pesticide will not be unreasonable? (Section 6 and 1 of the Pesticide Control Act.)

b. Have other statutory requirements of the Pesticide Control Act and Regulations been carried out?

c. Have the rules of natural justice been followed?

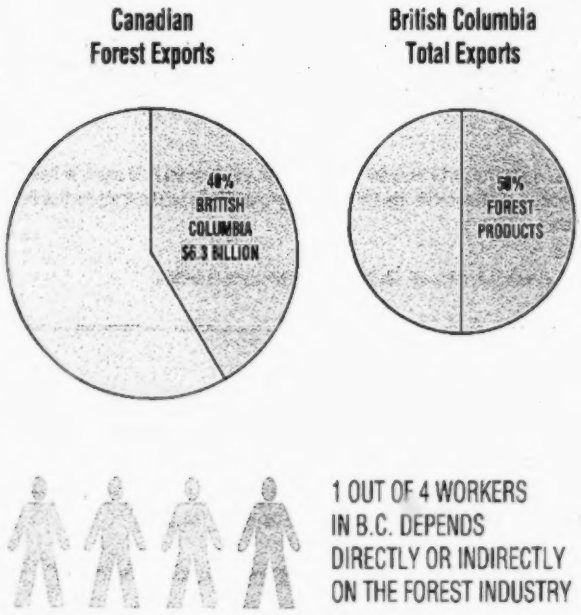
Reference

Procedural Regulations of the Environmental Appeal Board, 1982. Amended 1985. British Columbia Environmental Appeal Board, Ministry of Environment. Queen's Printer for British Columbia, Victoria.

2.1 The Importance of Forestry to British Columbia and Canada

1 OUT OF 4 WORKERS
IN B.C. DEPENDS
DIRECTLY OR INDIRECTLY
ON THE FOREST INDUSTRY

2.1 The Importance of Forestry to British Columbia and Canada



An Overview of the B.C. Forest Industry

British Columbia's commercial forests cover more than half of the province's land area and support more than 8 billion cubic metres of mature timber. The stock of timber on those lands is about 40 percent of the Canadian inventory and about 20 percent of the North American inventory. More than 95 percent of this volume is coniferous (softwood). Forests of the coastal region contain more hemlock than any other species, while spruce and lodgepole pine are the major species of the interior region.

The forest industry is by far the most important sector of the provincial economy. In 1985, forest based manufacturing accounted for 45 percent of the total manufacturing shipments in the province, and 50 percent of total provincial exports. The value of B.C.'s exports of forest products in 1985 was greater than $6.3 billion. In comparison, B.C.'s exports of mineral products in 1985 totalled $3.9 billion.

Lumber is the leading B.C. forest product export ($2.8 billion in 1985) followed by wood pulp and newsprint. British Columbia accounted for 40 percent of the value of forest product exports from all of Canada in 1985.

Over 78 thousand persons are employed directly in the forest industry, and about twice this number are indirectly dependent on the forest sector for their livelihood in service industries such as transportation, capital repair, and construction. There are many communities and regions which are dependent on the forest resource as their major or only economic base. In total, one in every four B.C. workers depends directly or indirectly on the forest industry for employment.

The scope of the B.C. forest products industry is also apparent in the number of wood processing facilities situated throughout the province: 179 sawmills, 24 panelboard (primarily plywood) mills, 71 shake/shingle mills, and 24 pulp/paper mills.

In 1985, British Columbia's production accounted for (approximately) 65 percent of all the softwood lumber produced in Canada, 85 percent of the country's plywood, 30 percent of its pulp, 17 percent of its paper, and 90 percent of Canada's shingles and shakes.

The logging industry is the basis for the extensive wood related manufacturing industry. In 1985, timber production in the province exceeded 78.9 million m^3. Over 27 million m^3 were harvested in coastal forests and over 51 million m^3 in interior forests. The majority of the roundwood harvested is processed in sawmills.

Over 60 percent of the roundwood handled in sawmills is converted into wood chips and used as raw material for the pulp and paper industry. Most of the remaining roundwood production is used by the plywood and pulp and paper industries, and a relatively small proportion of the total harvest is processed by the shake and shingle industry.

Lumber production in 1985 was 14 billion board feet (33 million cubic metres). Production in the interior accounted for 10.4 billion board feet (24.5 million cubic metres) and coastal production accounted for 3.8 billion board feet (9 million cubic metres).

B.C. is the largest exporter of softwood lumber in the world. In 1985 over 56 percent of B.C.'s lumber production went to the United States, the major market for B.C. lumber. Approximately 30 percent went to Canadian markets, almost 7 percent to the Japanese market, and lesser amounts to the U.K., other European Economic Community (EEC) countries, Australia and other markets.

In 1985, provincial plywood production was 1.9 billion square feet, ⅜ inch basis (1.6 million cubic metres). Approximately 75 percent of British Columbia plywood production is used within Canada. Of the remaining production, almost 90 percent is exported to the EEC. The remainder is exported to Japan and other markets.

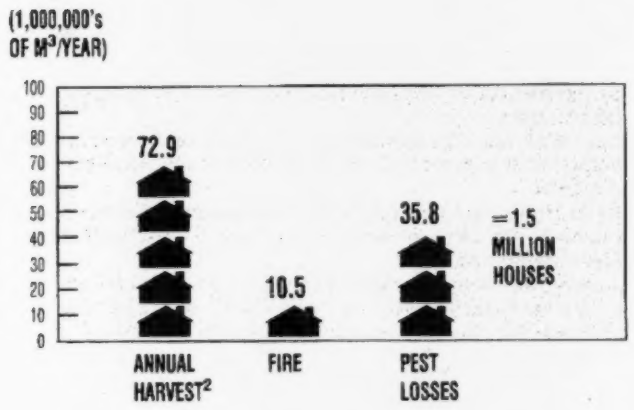
British Columbia's pulp production in 1985 was 5.8 million tonnes. Of this amount 3.3 million tonnes was exported. Major markets for B.C. pulp are the United States, the EEC and Japan. The total value of pulp exports in 1985 was $1.6 billion.

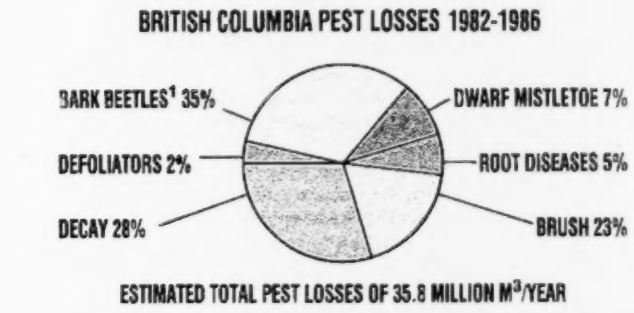
British Columbia's newsprint, paper and paperboard production in 1985 increased to a record level of 2.5 million tonnes. The total value of exports of paper, newsprint, and other paper products was $1.1 billion, bringing the total value of exports of pulp and paper products to $2.7 billion.

British Columbia is the major producer of shingles and shakes in Canada. During 1985 over 4 million squares were exported from British Columbia, 99 percent of which were exported to the U.S. The value of shingle and shake exports in 1985 was $233 million.

The importance of the forests and the forest industry to the Province of B.C. makes it imperative that the forests be managed and protected.

2.2 Estimated Current Annual Timber Harvest, Fire and Pest Losses in B.C. 1982-1986



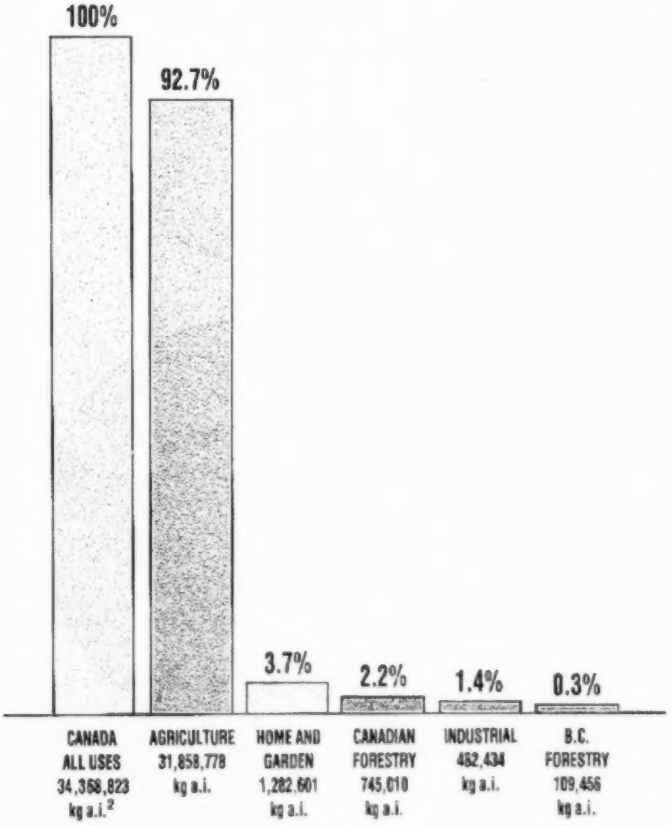


[1]Bark beetle losses have been calculated as gross losses (i.e. the total volume lost to bark beetles before salvage or harvesting)
[2]Annual Harvest is for the period 1982-1985

Source

Canadian Forestry Service; Forest Insect and Disease Survey, and B.C. Forest Service; Protection and Silviculture Branches

2.3 Relative Use of Pesticides in Canada and British Columbia[1]

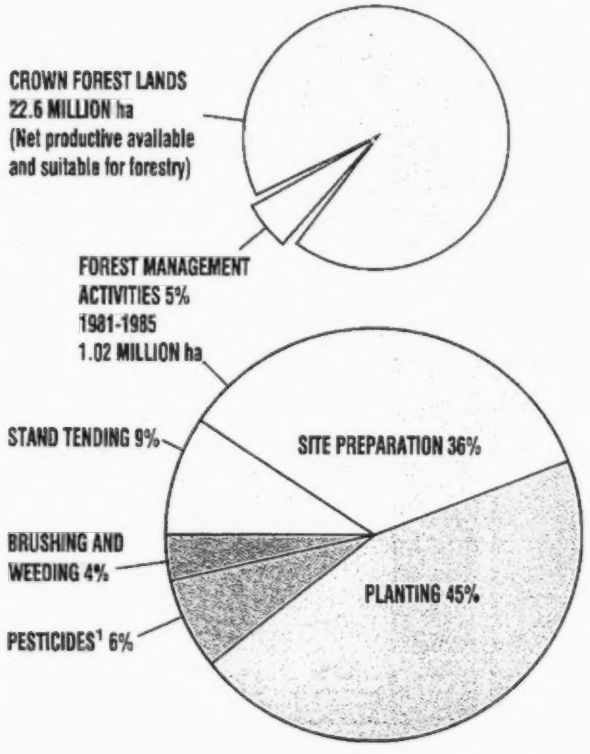


[1]Source

Pesticide Usage and Sales Data for 1985, Manitoba Agricultural Economics Analysis Branch and the Crop Protection Institute of Canada

[2]a.i. = active Ingredient

2.4 Forest Management Activities on Crown Forest Lands



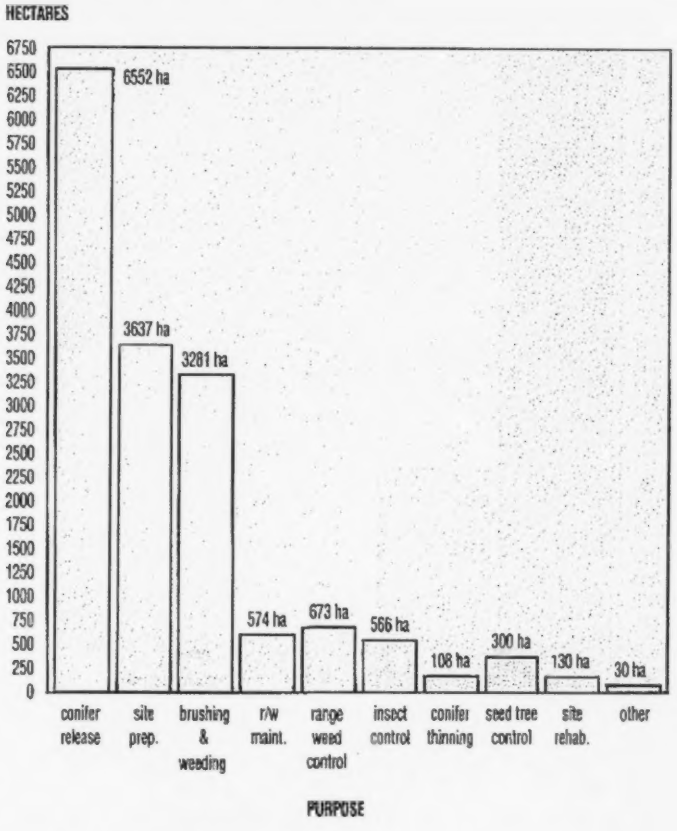
[1]Includes herbicides, insecticides, fungicides, deer repellants and rodenticides. Herbicides are employed for such purposes as site preparation, brushing, and weeding, conifer release, pre-commercial thinning, and rangeland weed control. All uses of pesticides have been summarized in this section.

References

Forest and Range Resource Analysis: Summary. 1984. Prepared by the Ministry of Forests, Strategic Studies Branch, Victoria. Report of the Ministry of Forests, Province of British Columbia Fiscal Years Ending March 31, 1982, 1983, 1984, 1985 and 1986. Queen's Printer, Victoria.

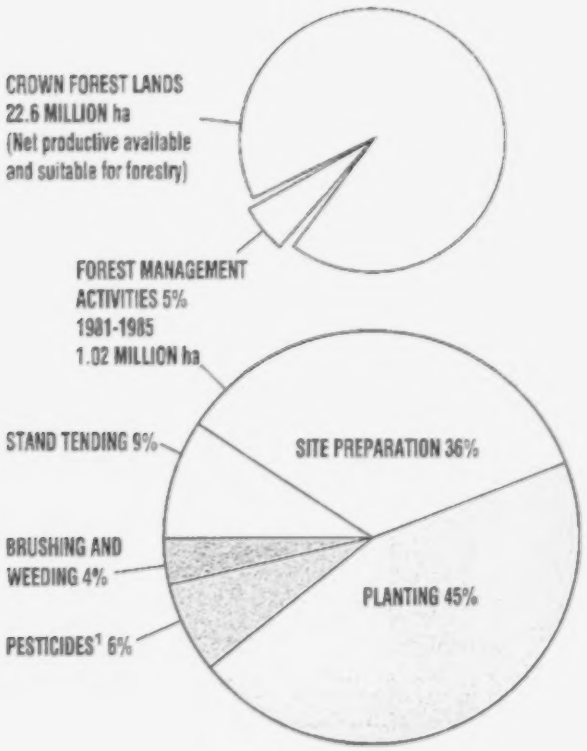
2.5 Pesticide Use in B.C. Forestry 1982-1986

PURPOSE
AVERAGE NUMBER OF HECTARES TREATED, 1982-1986



[1]Graphs include all forestry pesticide use (i.e. B.C. Forest Service and forest industry combined).

2.4 Forest Management Activities on Crown Forest Lands



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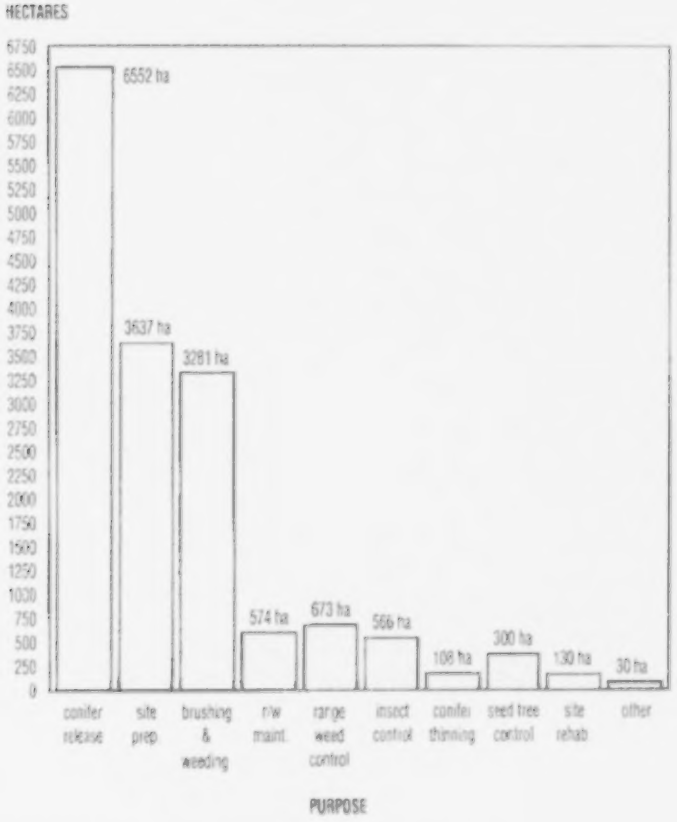

[1]Graphs include all forestry pesticide use (i.e. B.C. Forest Service and forest industry combined).

METHOD
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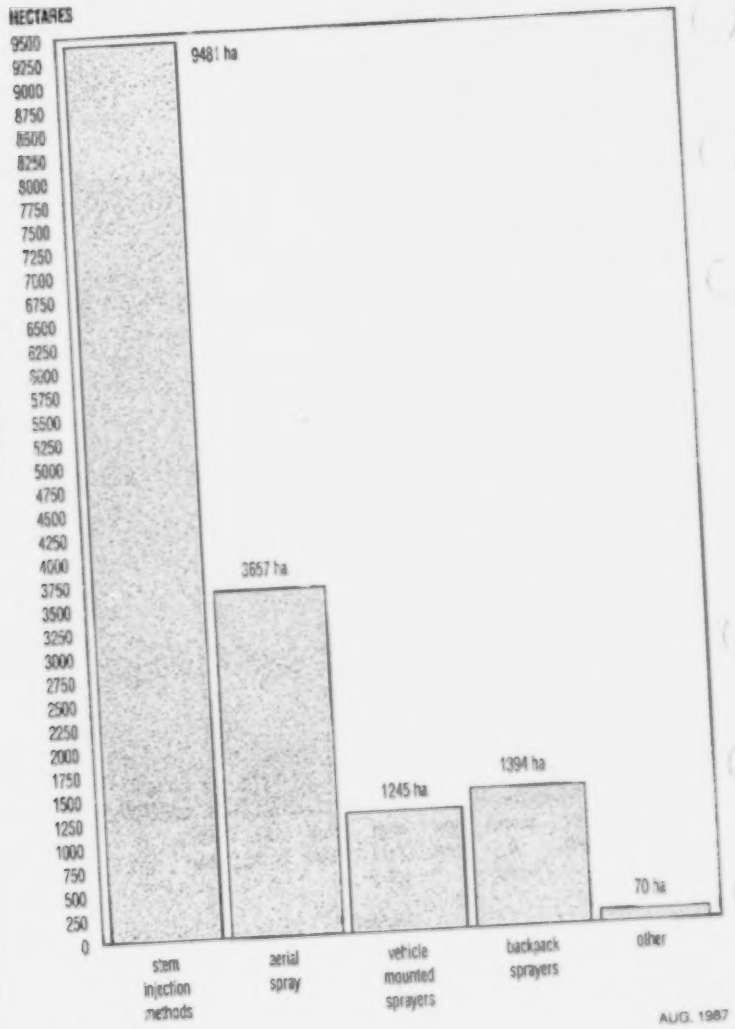

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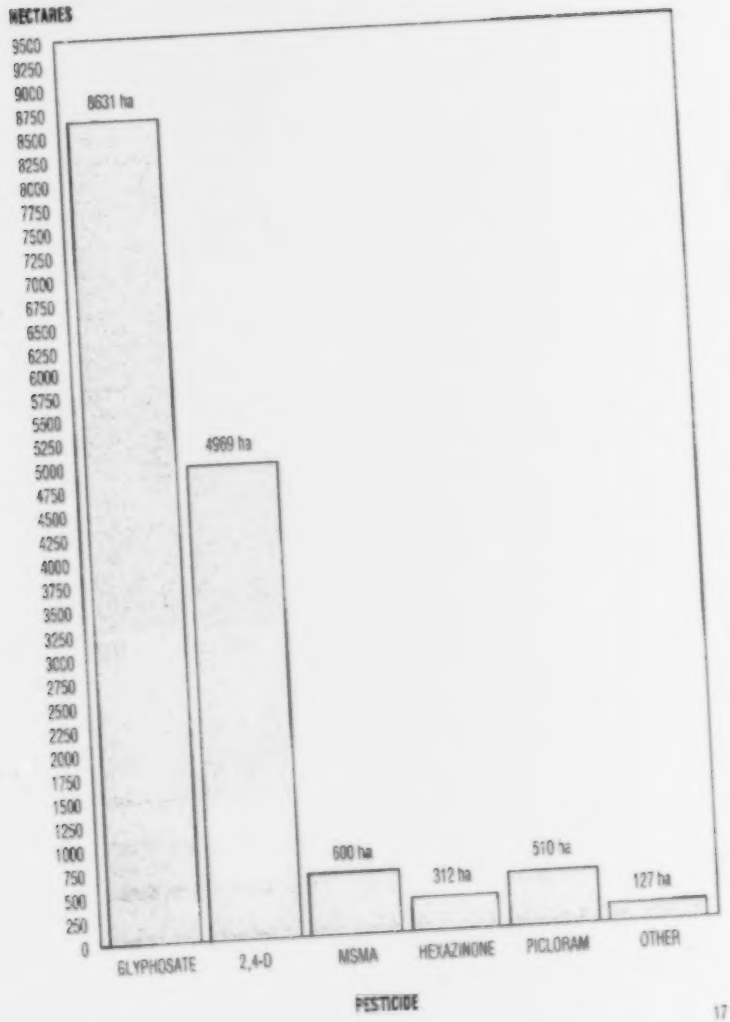
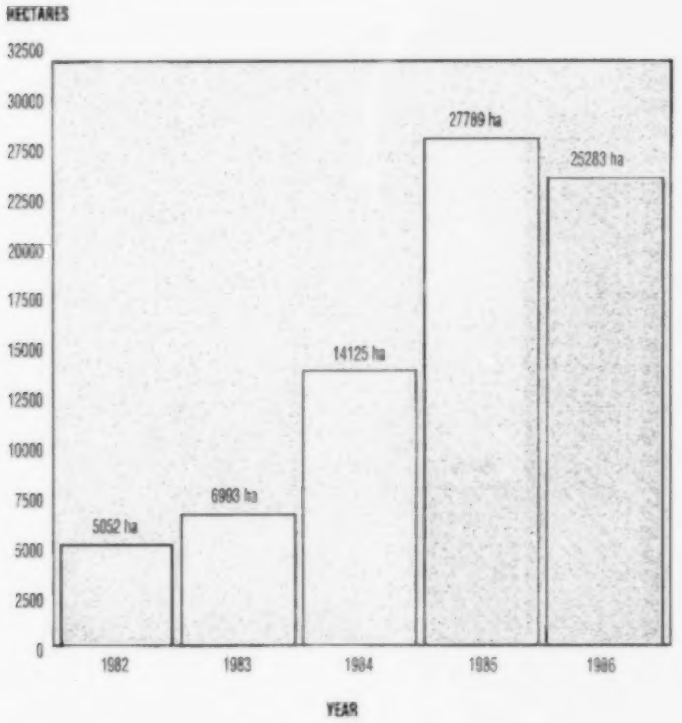
PESTICIDE
AVERAGE NUMBER OF HECTARES TREATED, 1982-1986



TRENDS IN PESTICIDE USE, 1982-1986



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_____, 1986. Pesticide Use in British Columbia Forestry, 1985. B.C. Ministry of Forests and Lands. Internal Report PM-PB-26

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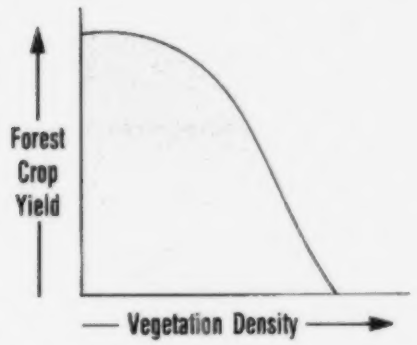
_____, 1983. Pesticide use in British Columbia Forestry, 1982. B.C. Ministry of Forests. Internal Report PM-PB-11.

2.6 Vegetation Management and Forest Productivity[1]



A few weeds usually do not affect yield but total crop loss usually occurs at less than maximum weed density

Results (% injury) of Various Vegetation Control Methods

	Target Species					
METHOD	Huckleberry	Salmon-berry/ Thimbleberry	Vine Maple	Red Alder	Bracken Fern	Grasses
Manual	60-90%	< 25%	< 25%	< 25%	< 25%	< 25%
Mechanical	60-90%	60-90%	?	> 90%	25-60%	< 25%
Burning	90-100%	60-90%	?	< 25%	< 25%	< 25%
Chemical Herbicide	> 90%	> 90%	60-90%	> 90%	> 90%	> 90%
Season	Late Summer	Late Summer	Late Summer	Late Summer	Summer	Summer

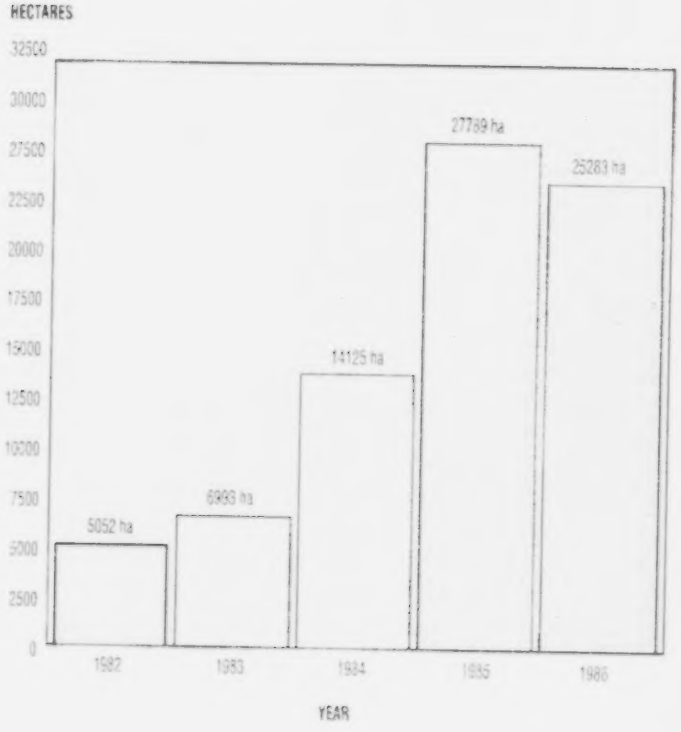
[1]Sources

Zimdahl, R.L. 1980. Weed-Crop Competition: A Review. International Plant Protection Centre. Oregon State University.

Wagner, B. and S. Radosevich. 1986. Principles of Forest Vegetation Management. Oregon State University.

Silviculture Branch, Ministry of Forests and Lands. Victoria, B.C.

TRENDS IN PESTICIDE USE, 1982-1986



References

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_____, 1986. Pesticide Use in British Columbia Forestry, 1985. B.C. Ministry of Forests and Lands. Internal Report PM-PB-26.

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_____, 1983. Pesticide use in British Columbia Forestry, 1982. B.C. Ministry of Forests. Internal Report PM-PB-11.

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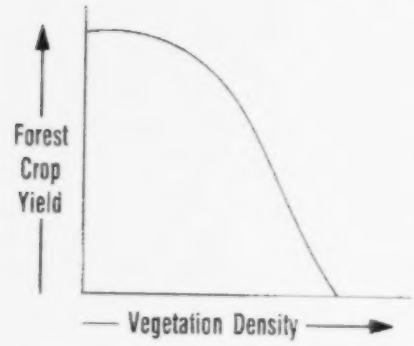
2.6 Vegetation Management and Forest Productivity[1]



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Wagner, B. and S. Radosevich. 1986. Principles of Forest Vegetation Management. Oregon State University.

Silviculture Branch, Ministry of Forests and Lands. Victoria, B.C.

3.1 Identifying, Planning and Conducting a Pesticide Project

1. PEST PROBLEM
   - Does it exist? (Determined by pre-harvest survey.)
   - What is the extent and severity? (The area suitable for control is identified, and the economic implications of control vs. no control are examined.)

2. CONTROL DECISION (see section 3.2)
   - There are usually several control options, such as:
     - cutting/clipping
     - logging
     - burning
     - pesticides
     - biological control agents
     - combination of above

3. CONTROL ACTION
   - Involves four basic steps:
     a) Establish an Action Plan
        - personnel must be informed re transport, storage and safety.
     b) Apply for a Pesticide Use Permit
        - application must include maps showing environmental risks such as water bodies and human settlements.
     c) Implement Project
        - must be carried out subject to conditions listed on permit.
     d) Evaluate Results
        - may involve such things as spray coverage, droplet size, drift, impact of control program, compliance with permit.

Sources

Forest Pesticide Handbook of British Columbia. 1985. Second Edition. Revised by J.F. Henigman and J.D. Beardsley. Council of Forest Industries of British Columbia. Province of British Columbia, Ministry of Forests.

B.C. Ministry of Forests and Lands, Silviculture, Prince George Region and Prince Rupert Region.

Conard S.G. and W.H. Emmingham. 1984. Herbicides for Clump and Stem Treatment of Weed Trees and Shrubs in Oregon and Washington. Special Publ. No. 9 Forest Research Laboratory. College of Forestry, Oregon State University.

3.2 Abbreviated Decision-Making Profile for Insect and Weed Control Operations

Prior to each field operation, forest resource personnel are obliged to consider a wide variety of factors. This procedure in decision-making is designed not only to consider benefits, costs and risks, but to ensure the **BEST POSSIBLE CHOICE OF TREATMENT**. Presently, this procedure is being used for insect and weed/brush problems in B.C. forest management.

The procedure, a profile comparing a minimum of three possibilities or alternatives, assumes **PREVENTION** is not possible and that a strategy for **SUPPRESSION** of the target pest (i.e., insect, weed species) must be determined. One of the end results will be the **NO TREATMENT** option which may result from consideration of environmental, economic, or social concerns. In the case of special situations, a regional-level Decision Review Committee may evaluate a treatment proposal for final approval or rejection. In all cases only the best treatment recommendation will result.

THE PROFILE

The profile consists of a brief **FORM** to be completed and signed via accompanying **GUIDELINES**.

STEP 1 Considers background information concerning the site, its location, and a brief description of the vegetation present.

STEP 2 Considers the nature of the problem and the reasons why treatment may be required.

STEP 3 Involves the selection of three potential treatments (minimum) as well as early consideration of the No Treatment alternative.

STEP 4 Requires ranking of various factors affecting each of the three chosen treatment options into any one of five categories (zero, low, moderate, moderately high, very high probability of occurrence). The factors for systematic consideration include:

- Cost
- Risk to operators
- Effect on potable water
- Effect on soil
- Effect on aesthetics
- Difficulty for crew or machinery
- Reoccurrence of pest (need for retreatment)
- Risk to wildlife
- Risk to fish/fish food
- Difficulty of terrain (for treatment)
- Effect on other non-target species (plants, animals)
- Human health - general
- Concerns of special interest groups
- Effects on range (animals/forage)
- Difficulty for operator
- Risk to crop (injury)
- Other (specific)

STEP 5 Evaluates each treatment via tally of rankings with each treatment. Treatment with lowest ranking leads to recommendation.

STEP 6 Requires selection and recommendation of the best treatment based on this evaluation of efficacy, cost, and environmental acceptability.

3.3 Pesticides vs. Other Methods – Costs, Advantages, and Disadvantages for Control of Some Major Forest Weeds

TARGET SPECIES: RED ALDER

PURPOSE	SITE PREPARATION		CONIFER RELEASE	
	HERBICIDE GROUND	HERBICIDE AERIAL	MANUAL	HERBICIDE AERIAL
METHOD	• backpack spray • glyphosate	• helicopter spray • glyphosate	• stem girdling	• helicopter spray • glyphosate or 2,4-D amine
EFFECTIVENESS	 60 - 90%	 60 - 90%	 60 - 90%	 90 - 100%
DURATION	5 + years	5 + years	5 + years	5 + years
ADVANTAGES	• low site impact • high selectivity • prepares site for burning	• relatively safe to worker(s) • low site impact • environmentally safe • effectiveness per unit cost • prepares site for burning	• low site impact • high selectivity	• relatively safe to worker(s) • low site impact • effectiveness per unit cost • high selectivity
DISADVANTAGES	• special worker safety precautions required	• drift potential	• high cost • effectiveness highly dependent on worker performance	• drift potential • possible damage to crop trees
COST	$330/ha average	$210/ha average	$510/ha average	$210/ha average

TARGET SPECIES: SALMONBERRY/THIMBLEBERRY

PURPOSE	SITE PREPARATION		CONIFER RELEASE	
	MANUAL CUTTING	HERBICIDE AERIAL	MANUAL CUTTING	HERBICIDE GROUND
METHOD	• chainsaw • brush saw	• helicopter spray • glyphosate	• chainsaw • brush saw	• stem injection • glyphosate or 2,4-D amine
EFFECTIVENESS	 <25%	 90 - 100%	 <25%	 90 - 100%
DURATION	2 years	5 + years	2 years	5 + years
ADVANTAGES	• low site impact • prepares site for burning	• relatively safe to worker(s) • environmentally safe • low site impact • effectiveness per unit cost • prepares site for burning	• good for environmentally sensitive areas • low site impact • high selectivity	• environmentally safe • low site impact • effectiveness • high selectivity
DISADVANTAGES	• relatively dangerous to worker(s) • high cost • stimulates re-sprouting of some species	• drift potential	• relatively dangerous to worker(s) • high cost • stimulates re-sprouting • multiple treatments required due to ineffectiveness • possible crop tree injury • may cause release shock in crop trees	• special worker safety precautions required
COST	$590/ha average	$210 average	$590/ha average	$350/ha average

Sources

Conard, Susan G. 1984. Forest Vegetation Management in British Columbia. Problem Analysis. Ministry of Forests Research Report FIR 84301 HQ. Victoria. 119 p.

Ministry of Forests and Lands, Silviculture Branch, Victoria.

Wagner R. and S. Radosevich. 1986. Principles of Forest Vegetation Management. Field Trip presentation in Kamloops (1985) and Prince George (1985). Oregon State University.

3.3 Pesticides vs. Other Methods – Costs, Advantages, and Disadvantages for Control of Some Major Forest Weeds

TARGET SPECIES: RED ALDER

METHOD	SITE PREPARATION		CONIFER RELEASE	
	HERBICIDE GROUND	HERBICIDE AERIAL	MANUAL	HERBICIDE AERIAL
METHOD	• backpack spray • hydraulic	• helicopter spray • hydraulic	• slashing/brushing	• helicopter spray • mixture of 2,4-D and dicamba
EFFECTIVENESS	60 - 90%	60 - 90%	60 - 70%	90 - 100%
DURATION	5 + years	5 + years	5 + years	5 + years
ADVANTAGES	• low site impact • high selectivity • prepares site for burning	• relatively safe to administer • low site impact • environmentally safe • effectiveness per unit cost • prepares site for burning	• low site impact • high selectivity	• relatively safe to administer • low site impact • effectiveness per unit cost • high selectivity
DISADVANTAGES	• special worker safety precautions required	• dirt potential	• high cost • effectiveness highly dependent on worker performance	• dust potential • possible damage to crop trees
COST	$300/ha average	$210/ha average	$510/ha average	$210/ha average

TARGET SPECIES: SALMONBERRY/THIMBLEBERRY

PURPOSE	SITE PREPARATION		CONIFER RELEASE	
	MANUAL CUTTING	HERBICIDE AERIAL	MANUAL CUTTING	HERBICIDE GROUND
METHOD	• chainsaw • brush saw	• helicopter spray • glyphosate	• chainsaw • brush saw	• stem injection • glyphosate or 2,4-D amine
EFFECTIVENESS	 ~25%	 90 - 100%	 ~25%	 90 - 100%
DURATION	2 years	5 + years	2 years	5 + years
ADVANTAGES	• low site impact • prepares site for burning	• relatively safe to worker(s) • environmentally safe • low site impact • effectiveness per unit cost • prepares site for burning	• good for environmentally sensitive areas • low site impact • high selectivity	• environmentally safe • low site impact • effectiveness • high selectivity
DISADVANTAGES	• relatively dangerous to worker(s) • high cost • stimulates re-sprouting of some species	• drift potential	• relatively dangerous to worker(s) • high cost • stimulates re-sprouting • multiple treatments required due to ineffectiveness • possible crop tree injury • may cause release shock in crop trees	• special worker safety precautions required
COST	$590/ha average	$210 average	$590/ha average	$450/ha average

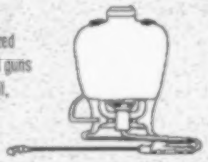
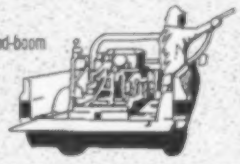
Sources

United States Dept. of Agriculture, Forest Service, Pacific Northwest Region. Vegetation Management in the Douglas-fir Region. Portland, Oregon, 1983.

Weyerhaeuser Company. Silviculture Guide. 4 Vols.

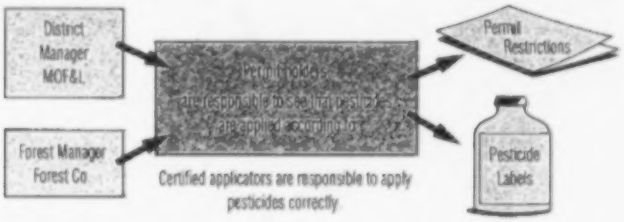
Wagner, R. G. and S. Radosevich. 1987. Predicting Effects of Herbicides on Douglas-fir Tanoak and Pacific Madrone Growth. Oregon State University.

3.4 Methods of Applying Pesticides

METHODS	PESTICIDES	TARGET EXAMPLES
AERIAL helicopters or fixed-wing aircraft	glyphosate	alder, salmonberry, birch, grass, willow, aspen, thimbleberry, elderberry
	Bacillus thuringiensis	western spruce budworm
GROUND 1. CUT SURFACE includes hack and squirt treatments where pesticide is squirted into cut on stem of target vegetation; or stump treatments where pesticide is applied to stump to prevent resprouting	2,4-D	alder
	MSMA	conifers, spruce beetle
2. BACKPACK includes pressurized sprayers and spot guns used to treat small, specific areas 	glyphosate	grass, alder, willow, aspen, birch, elderberry, salmonberry, thimbleberry
	hexazinone	grasses, fireweed, aspen willow, birch, cottonwood
3. VEHICLE nozzle or fixed-boom sprayers 	picloram	noxious weeds: thistle knapweed
	carbaryl	Douglas-fir tussock moth
4. HAND involves granules or pellets applied to ground near target vegetation	picloram	knapweed, thistle broadleaf, leafy spurge

3.5 Precautions Taken When Applying Pesticides

RESPONSIBILITY FOR TREATMENTS



PROTECTION OF ENVIRONMENT

No pesticides sprayed in winds over 8 km/h

No pesticides sprayed in temperatures over 25°C.

No pesticides sprayed far from target

No pesticides sprayed when relative humicity is less than 50%

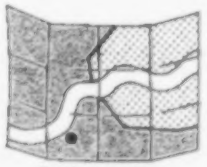
No pesticides sprayed close to water used for fisheries, irrigation, or domestic uses

No pesticides applied on steep terrain, loose soil, drainage channels

PROTECTION OF BYSTANDERS

Treatment area searched

Roads blocked and posted



Potable water noted and buffered

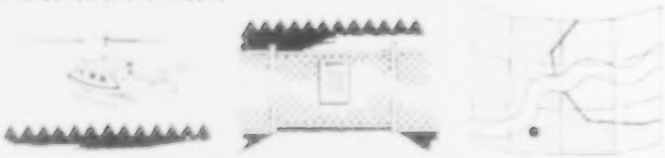
3.4 Methods of Applying Pesticides

3.5 Precautions Taken When Applying Pesticides

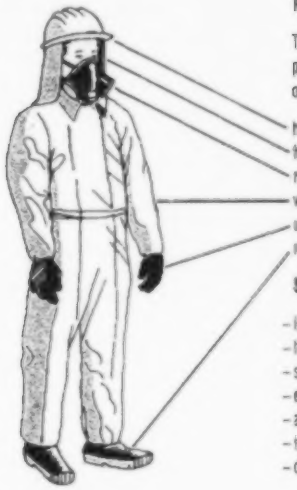
RESPONSIBILITY FOR TREATMENTS

PROTECTION OF ENVIRONMENT

PROTECTION OF BYSTANDERS



PROTECTION OF APPLICATORS



PROTECTIVE CLOTHING

The need for specific protective clothing depends on the method of treatment.

- hard hat
- face shield
- respirator
- waterproof suit
- unlined rubber gloves
- rubber boots

SAFE WORK HABITS

- inspect pesticide containers
- handle containers carefully
- store pesticide away from food
- eat/drink away from work area
- avoid touching eyes/mouth while working
- shower after work
- discard contaminated clothing

PROVISION FOR FIRST AID

first aid kits

eyewash

nurse or first aid attendant

PROVISION FOR DECONTAMINATION OF SPILLS

barricade absorb neutralize dispose*

*In the case of a very large spill, specialists from the Pesticide Control Branch would be called in.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Ambush ®
Common Name	permethrin
Mode of Action	contact insecticide; nerve poison
Target Species[1]	black army cutworm
History of Use	since mid 1970s in agriculture and 1980s in forestry
Formulated With	petroleum distillates, emulsifiers
Mixed With	water
Application Methods	back pack ground sprays
Major Forestry Uses[2]	used to control black army cutworm, a pest that attacks conifer seedlings.
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	430-4000 mg/kg
Toxicity Rating	slight
Chronic Toxicology	
Cancer	might be cancer causing at high exposure and dosage rates
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	3000 mg/kg
LC50[5] (salmonid)	0.01 mg/L
Fate	
Half Life[6]	2 weeks – 1 month
Soil	very mobile in soil
Water	not soluble in water
Bioaccumulation	none

See page 38 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Ambush ®
Common Name	permethrin
Mode of Action	contact insecticide; nerve poison
Target Species[1]	black army cutworm
History of Use	since mid 1970s in agriculture and 1980s in forestry
Formulated With	petroleum distillates, emulsifiers
Mixed With	water
Application Methods	back pack ground sprays
Major Forestry Uses[2]	used to control black army cutworm, a pest that attacks conifer seedlings.
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	430-4000 mg/kg
Toxicity Rating	slight
Chronic Toxicology	
Cancer	might be cancer causing at high exposure and dosage rates
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	3000 mg/kg
LC50[5] (salmonid)	0.01 mg/L
Fate	
Half Life[6]	2 weeks – 1 month
Soil	very mobile in soil
Water	not soluble in water
Bioaccumulation	none

See page 38 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Forestamine ®, Guardsman®
Common Name	2,4-D amine
Mode of Action	foliar active, causes abnormal growth response in plants
Target Species[1]	alder and willow
Route of Uptake	stem cut surface, some foliar uptake
History of Use	since 1946 in agriculture, since mid 1950s in forestry
Formulated With	water, methanol
Mixed With	water
Application Methods	stump treatment, some aerial and ground sprays, stem injection
Major Forestry Uses[2]	site preparation, brushing and weeding, conifer release, right-of-way maintenance
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	370 mg/kg (2,4-D acid)
Toxicity Rating	moderate
Chronic Toxicology	
Cancer	may be cancer causing at high dosage and exposure rates
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	400 mg/kg (2,4-D acid)
LC50[5] (salmonid)	250 mg/L (2,4-D amine)
Fate	
Half Life[6]	1 month
Soil	readily degraded by microbial activity
Water	readily degraded by microbial activity and light
Bioaccumulation	none

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Forester©, Esteron®
Common Name	2,4-D ester
Mode of Action	foliar active, causes abnormal growth response in plants
Target Species[1]	alder and willow
Route of Uptake	foliage
History of Use	since 1946 in agriculture, since mid 1950s in forestry
Formulated With	petroleum distillates
Mixed With	oil, water
Application Methods	ground and aerial sprays
Major Forestry Uses[2]	site preparation, brushing and weeding, conifer release
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	370 mg/kg (2,4-D acid)
Toxicity Rating	moderate
Chronic Toxicology	
Cancer	may be cancer causing at high exposure and dosage rate
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	400 mg/kg (2,4-D acid)
LC50[5] (salmonid)	1 mg/L (2,4-D ester)
Fate	
Half Life[6]	1 month
Soil	readily degraded by microbial activity
Water	readily degraded by microbial activity and light
Bioaccumulation	none

See page 38 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Forestamine ®, Guardsman®
Common Name	2,4-D amine
Mode of Action	foliar active, causes abnormal growth response in plants
Target Species[1]	alder and willow
Route of Uptake	stem cut surface, some foliar uptake
History of Use	since 1946 in agriculture, since mid 1950s in forestry
Formulated With	water, methanol
Mixed With	water
Application Methods	stump treatment, some aerial and ground sprays, stem injection
Major Forestry Uses[2]	site preparation, brushing and weeding, conifer release, right-of-way maintenance
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	370 mg/kg (2,4-D acid)
Toxicity Rating	moderate
Chronic Toxicology	
Cancer	may be cancer causing at high dosage and exposure rates
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	400 mg/kg (2,4-D acid)
LC50[5] (salmonid)	250 mg/L (2,4-D amine)
Fate	
Half Life[6]	1 month
Soil	readily degraded by microbial activity
Water	readily degraded by microbial activity and light
Bioaccumulation	none

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Forester®, Esteron®
Common Name	2,4-D ester
Mode of Action	foliar active, causes abnormal growth response in plants
Target Species[1]	alder and willow
Route of Uptake	foliage
History of Use	since 1946 in agriculture, since mid 1950s in forestry
Formulated With	petroleum distillates
Mixed With	oil, water
Application Methods	ground and aerial sprays
Major Forestry Uses[2]	site preparation, brushing and weeding, conifer release
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	370 mg/kg (2,4-D acid)
Toxicity Rating	moderate
Chronic Toxicology	
Cancer	may be cancer causing at high exposure and dosage rate
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	400 mg/kg (2,4-D acid)
LC50[5] (salmonid)	1 mg/L (2,4-D ester)
Fate	
Half Life[6]	1 month
Soil	readily degraded by microbial activity
Water	readily degraded by microbial activity and light
Bioaccumulation	none

See page 38 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Garlon®
Common Name	triclopyr ester
Mode of Action	foliar active; causes abnormal growth response in plants
Target Species[1]	shrubs, weed trees, evergreen brush
Route of Uptake	foliage and stem cut surface
History of Use	since 1980 in U.S., may be registered for forestry in Canada by 1989
Formulated With	petroleum distillates
Mixed With	oil and water
Application Methods	aerial and ground sprays, stem injection, stump treatment
Major Forestry Uses[2]	site preparation, conifer release
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	630-729 mg/kg
Toxicity Rating	slight
Chronic Toxicology	
Cancer	none
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	1698 mg/kg
LC50[5] (salmonid)	0.7-2.24 mg/L
Fate	
Half Life[6]	1-2 months
Soil	rapidly degraded by micro-organisms
Water	rapidly degraded, mainly by light
Bioaccumulation	none in fish, no data available for mammals

See page 38 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Glowon®
Common Name	M.S.M.A.
Mode of Action	desiccation and fumigation of cambium with arsine gas
Target Species[1]	immature conifers
Route of Uptake	stem cut surface
History of Use	since mid 1950s in agriculture and forestry
Formulated With	a surfactant
Mixed With	water
Application Methods	stem injection
Major Forestry Uses[2]	pre-commercial thinning and bark beetle control
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	173 mg/kg
Toxicity Rating	moderate
Chronic Toxicology	
Cancer	data not available
Mutations	none
Birth Defects	data not available
Nerve Damage	data not available
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	5000 mg/kg
LC50[5] (salmonid)	1 - 100 mg/L
Fate	
Half Life[6]	stable
Soil	very immobile, occurs naturally in soils, quickly binds to soil and becomes inactivated
Water	no contamination of streams has been observed
Bioaccumulation	observed in some aquatic organisms but not expected to become concentrated in food chains

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Garlon®
Common Name	triclopyr ester
Mode of Action	foliar active; causes abnormal growth response in plants
Target Species[1]	shrubs, weed trees, evergreen brush
Route of Uptake	foliage and stem out surface
History of Use	since 1980 in U.S., may be registered for forestry in Canada by 1989
Formulated With	petroleum distillates
Mixed With	oil and water
Application Methods	aerial and ground sprays, stem injection, stump treatment
Major Forestry Uses[2]	site preparation, conifer release
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	630-729 mg/kg
Toxicity Rating	slight
Chronic Toxicology	
Cancer	none
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	1698 mg/kg
LC50[5] (salmonid)	0.7-2.24 mg/L
Fate	
Half Life[6]	1-2 months
Soil	rapidly degraded by micro-organisms
Water	rapidly degraded, mainly by light
Bioaccumulation	none in fish, no data available for mammals

See page 39 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Glowonil
Common Name	M.S.M.A.
Mode of Action	desiccation and fumigation of cambium with arsine gas
Target Species[1]	immature conifers
Route of Uptake	stem cut surface
History of Use	since mid 1950s in agriculture and forestry
Formulated With	a surfactant
Mixed With	water
Application Methods	stem injection
Major Forestry Uses[2]	pre-commercial thinning and bark beetle control
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	173 mg/kg
Toxicity Rating	moderate
Chronic Toxicology	
Cancer	data not available
Mutations	none
Birth Defects	data not available
Nerve Damage	data not available
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	5000 mg/kg
LC50[5] (salmonid)	1 - 100 mg/L
Fate	
Half Life[6]	stable
Soil	very immobile, occurs naturally in soils, quickly binds to soil and becomes inactivated
Water	no contamination of streams has been observed
Bioaccumulation	observed in some aquatic organisms but not expected to become concentrated in food chains

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Orthene®
Common Name	acephate
Mode of Action	contact insecticide
Target Species[1]	spruce budworm, gypsy moth, tent caterpillar, Douglas-fir tussock moth
History of Use	since 1971 in forestry
Formulated With	petroleum distillates, emulsifiers
Mixed With	water
Application Methods	backpack and aerial sprays
Major Forestry Uses[2]	control of insects that eat foliage
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	700 mg/kg
Toxicity Rating	slight
Chronic Toxicology	
Cancer	none
Mutations	none
Birth Defects	none
Nerve Damage	yes, upon significant or lengthy exposure
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	350 mg/kg
LC50[5] (salmonid)	1000 mg/L
Fate	
Half Life[6]	1-2 weeks
Soil	readily leached by water and degraded by micro-organisms
Water	breakdown dependent on temperature and pH, half life in water is 46 days
Bioaccumulation	none

See page 38 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Vision®
Common Name	glyphosate
Mode of Action	foliar active, inhibits aromatic amino acid synthesis
Target Species[1]	annual and perennial weeds, brush trees
Route of Uptake	foliage and stem cut surface
History of Use	since 1976 in agriculture, since 1984 in forestry
Formulated With	a surfactant
Mixed With	water
Application Methods	ground and aerial sprays, stem injection
Major Forestry Uses[2]	site preparation, brushing and weeding, conifer release
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	5400 mg/kg
Toxicity Rating	slight
Chronic Toxicology	
Cancer	none
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	4640 mg/kg
LC50[5] (salmonid)	11 mg/L
Fate	
Half Life[6]	2 months
Soil	very immobile in soil, rapidly degraded by micro-organisms
Water	adsorbed to organic and mineral particles and degraded by micro-organisms
Bioaccumulation	none

See page 38 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Orthene®
Common Name	acephate
Mode of Action	contact insecticide
Target Species[1]	spruce budworm, gypsy moth, tent caterpillar, Douglas-fir tussock moth
History of Use	since 1971 in forestry
Formulated With	petroleum distillates, emulsifiers
Mixed With	water
Application Methods	backpack and aerial sprays
Major Forestry Uses[2]	control of insects that eat foliage
HUMAN HEALTH	
Acute Toxicology	
$LD50^3$ (mammal)	700 mg/kg
Toxicity Rating	slight
Chronic Toxicology	
Cancer	none
Mutations	none
Birth Defects	none
Nerve Damage	yes, upon significant or lengthy exposure
ENVIRONMENTAL EFFECTS	
Toxicology	
$LD50^4$ (bird)	866 mg/kg
$LC50^5$ (salmonid)	1000 mg/L
Fate	
Half Life[6]	1-2 weeks
Soil	readily leached by water and degraded by micro-organisms
Water	breakdown dependent on temperature and pH, half life in water is 46 days
Bioaccumulation	none

See page 38 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Vision®
Common Name	glyphosate
Mode of Action	foliar active, inhibits aromatic amino acid synthesis
Target Species[1]	annual and perennial weeds, brush trees
Route of Uptake	foliage and stem cut surface
History of Use	since 1976 in agriculture, since 1984 in forestry
Formulated With	a surfactant
Mixed With	water
Application Methods	ground and aerial sprays, stem injection
Major Forestry Uses[2]	site preparation, brushing and weeding, conifer release
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	5400 mg/kg
Toxicity Rating	slight
Chronic Toxicology	
Cancer	none
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	4640 mg/kg
LC50[5] (salmonid)	11 mg/L
Fate	
Half Life[6]	2 months
Soil	very immobile in soil, rapidly degraded by micro-organisms
Water	adsorbed to organic and mineral particles and degraded by micro-organisms
Bioaccumulation	none

See page 38 for all footnotes

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Sevin®
Common Name	carbaryl
Mode of Action	contact insecticide, nerve poison
History of Use	since 1958 in agriculture, since mid 1960s in forestry
Target Species[1]	gypsy moth, Douglas-fir tussock moth and spruce budworm
Formulated With	petroleum distillates
Mixed With	water or oil
Application Methods	backpack and aerial sprays
Major Forestry Uses[2]	to control insects that eat foliage
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	500 mg/kg
Toxicity Rating	slight
Chronic Toxicology	
Cancer	none
Mutations	none
Birth Defects	may cause birth defects at high dosage and exposure rates
Nerve Damage	yes, at very high dosage and exposure rates
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	2179 mg/kg
LC50[5] (salmonid)	0.76 mg/L
Fate	
Half Life[6]	1 month
Soil	degraded by microbial action
Water	degraded by chemical hydrolysis
Bioaccumulation	bioaccumulates in fish, little bioaccumulation in mammals

See page 38 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Thuricide®, Dipel®, Futura®
Common Name	Bacillus[7] thuringiensis (Kurstaki)
Mode of Action	stomach injestion, specific insect disease
Target Species[1]	spruce budworm, gypsy moth, Douglas-fir tussock moth
History of Use	since mid 1960s in agriculture, since mid 1970s in forestry
Formulated With	water, sugar and stabilizers
Mixed With	water
Application Methods	backpack and aerial sprays
Major Forestry Uses[2]	to control insects that eat foliage
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	no lethal dosage rates determined under practical exposure conditions
Toxicity Rating	not applicable
Chronic Toxicology	
Cancer	none
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	no lethal dosage rates determined under practical exposure conditions
LC50[5] (salmonid)	
Fate	
Half Life[6]	2 weeks (spores)
Soil	spores are degraded by light, may persist in soil for several months
Water	viable spores are not expected to persist for more than 1 month
Bioaccumulation	none

See page 38 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Sevin®
Common Name	carbaryl
Mode of Action	contact insecticide, nerve poison
History of Use	since 1958 in agriculture, since mid 1960s in forestry
Target Species[1]	gypsy moth, Douglas-fir tussock moth and spruce budworm
Formulated With	petroleum distillates
Mixed With	water or oil
Application Methods	backpack and aerial sprays
Major Forestry Uses[2]	to control insects that eat foliage
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	500 mg/kg
Toxicity Rating	slight
Chronic Toxicology	
Cancer	none
Mutations	none
Birth Defects	may cause birth defects at high dosage and exposure rates
Nerve Damage	yes, at very high dosage and exposure rates
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	2179 mg/kg
LC50[5] (salmonid)	0.76 mg/L
Fate	
Half Life[6]	1 month
Soil	degraded by microbial action
Water	degraded by chemical hydrolysis
Bioaccumulation	bioaccumulates in fish, little bioaccumulation in mammals

See page 38 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Thuricide®, Dipel®, Futura®
Common Name	Bacillus[7] thuringiensis (Kurstaki)
Mode of Action	stomach injestion, specific insect disease
Target Species[1]	spruce budworm, gypsy moth, Douglas-fir tussock moth
History of Use	since mid 1960s in agriculture, since mid 1970s in forestry
Formulated With	water, sugar and stabilizers
Mixed With	water
Application Methods	backpack and aerial sprays
Major Forestry Uses[2]	to control insects that eat foliage
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mamma)	no lethal dosage rates determined under practical exposure conditions
Toxicity Rating	not applicable
Chronic Toxicology	
Cancer	none
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	no lethal dosage rates determined under practical exposure conditions
LC50[5] (salmonid)	
Fate	
Half Life[6]	2 weeks (spores)
Soil	spores are degraded by light, may persist in soil for several months
Water	viable spores are not expected to persist for more than 1 month
Bioaccumulation	none

See page 38 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Velpar®, Pronone®
Common Name	hexazinone
Mode of Action	soil active, inhibits photosynthetic enzyme reactions
Target Species[1]	annual, biennial and perennial weeds and grasses, brush trees
Route of Uptake	foliage and roots
History of Use	since 1975 in agriculture, since 1984 in forestry
Formulated With	ethanol
Mixed With	water
Application Methods	ground sprays, spot gun
Major Forestry Uses[2]	site preparation, conifer release, brushing and weeding
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	1690 mg/kg
Toxicity Rating	slight
Chronic Toxicology	
Cancer	none
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	2250 mg/kg
LC50[5] (salmonid)	320-420 mg/L
Fate	
Half Life[6]	1-6 months
Soil	variably persistent in soil, degraded by light and microbial activity
Water	moderately persistent in water, degraded by light and microbial activity
Bioaccumulation	none

3.6 Major Forest Pesticides – Fact Sheets

GENERAL INFORMATION	
Product Name(s)	Virtuss®, Biotrol 1®
Common Name	nuclear polyhedrosis virus
Mode of Action	stomach injestion, specific insect disease
Target Species[1]	Douglas-fir tussock moth
History of Use	since 1985 in forestry
Formulated With	molasses and stabilizers
Mixed With	water
Application Methods	backpack and aerial sprays
Major Forestry Uses[2]	to control insects that eat foliage
HUMAN HEALTH	
Acute Toxicology	
LD50[3] (mammal)	no lethal dosage rates determined under practical exposure conditions
Toxicity Rating	not applicable
Chronic Toxicology	
Cancer	none
Mutations	none
Birth Defects	none
Nerve Damage	none
ENVIRONMENTAL EFFECTS	
Toxicology	
LD50[4] (bird)	no lethal dosage rates determined under practical exposure conditions
LC50[5] (salmonid)	
Fate	
Half Life[6]	years in soil, 2 weeks on foliage
Soil	NPV occurs naturally in the environment, degraded quickly by sunlight but may persist in soil for several years
Water	little information available about the fate of NPV in water
Bioaccumulation	none

See page 38 for all footnotes.

3.6 Major Forest Pesticides – Fact Sheets

Footnotes

[1]Apply to forestry only.

[2]Definitions of forestry uses:

Brushing and Weeding

Brushing and weeding is a cultural operation to control competing vegetation during the seedling stage of forest growth to promote the survival and growth of the crop trees.

Conifer Release

Conifer release is a treatment to free established coniferous trees from competition by eliminating or controlling growth that is overtopping or surrounding crop trees. The intent is to enhance growth rather than survival of crop trees.

Conifer Thinning (Juvenile Spacing, Pre-Commercial Thinning, Waste Thinning)

Conifer thinning is the reduction of density in young conifer stands, to control stocking, prevent stagnation and improve crop tree quality.

Site Preparation

Site preparation is any planned measure to prepare a site for the favourable reception and satisfactory growth of either naturally or artificially disseminated seed or planted seedlings.

[3]LD_{50}: lethal dose required to statistically kill 50% of the test animals; data presented is for rats unless otherwise noted. Data on the more toxic component, either product or active ingredient, is cited.

Lethal Dose 50% (LD_{50}) is a comparative measure of acute toxicity. It measures the amount of chemical in milligrams per kilogram of animal body weight required to statistically kill 50% of the animals tested. All chemicals are capable of killing any animal tested at some dosage rate. The smaller the dosage rate to kill an animal, the higher is the acute toxicity of the chemical.

[4]LD^{50}: data presented is for ducks or chickens. Data on the more toxic component, either product or active ingredients is cited.

[5]LC^{50}: data presented is for a salmon or trout species, most commonly rainbow trout were used. Data on the more toxic component, either product or active ingredient is cited.

Lethal Concentration 50% (LC^{50}) – the concentration of the chemical in water that will cause the death of fifty percent of the test fish in a given time, usually 96 hours. This concentration is expressed as parts per million or the number of milligrams of toxicant per litre of water.

[6]Half life: the period of time required for half of the existing chemical to break down in warm soils.

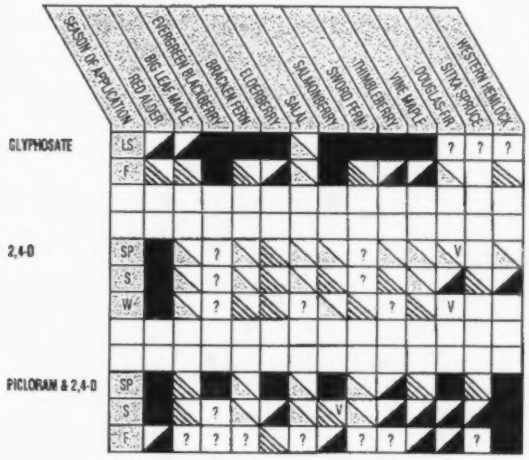
Sources:

Ghassemi, M. 1981. Environmental fates and impacts of major forest use pesticides. U.S. Environmental Protection Agency, Washington, D.C. 476 p.

U.S. Department of Agriculture Forest Service. 1984. Pesticides background statements: V.1. Herbicides. Handb. No. 633.1100 p.

Workers' Compensation Board of B.C. 1985. Standard practices for pesticide applicators. Vancouver, B.C. 140 p.

3.7 Effects of Herbicides on Some Species of Vegetation That Occur on Forest Sites in British Columbia

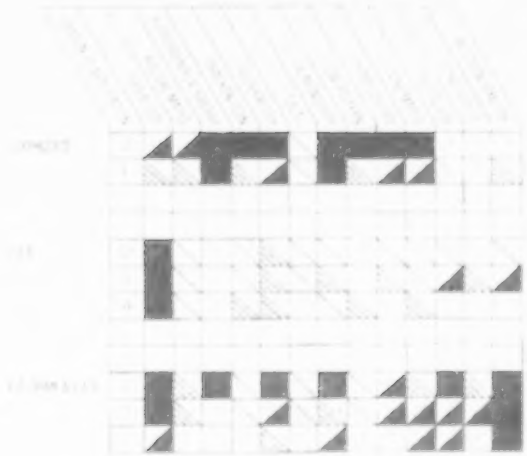


Sources

B.C. Ministry of Forests and Lands, Silviculture, Prince George Region and Prince Rupert Region.

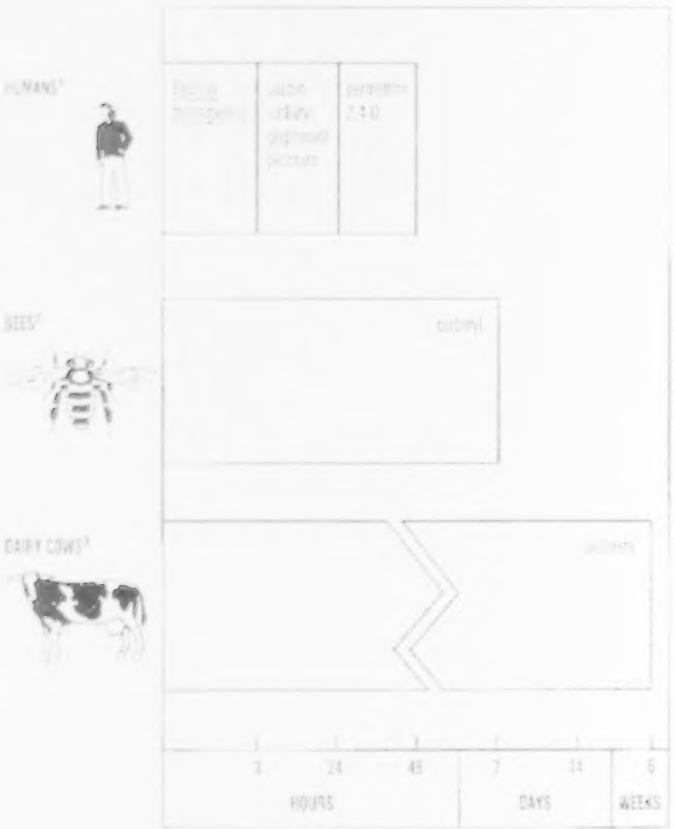
Conrad, S.G. and W.H. Emmingham. 1984. Herbicides for Clump and Stem Treatment of Weed Trees and Shrubs in Oregon and Washington. Special Publ. No. 9. Forest Research Laboratory. Oregon State University, College of Forestry.

3.7 Effects of Herbicides on Some Species of Vegetation That Occur on Forest Sites in British Columbia

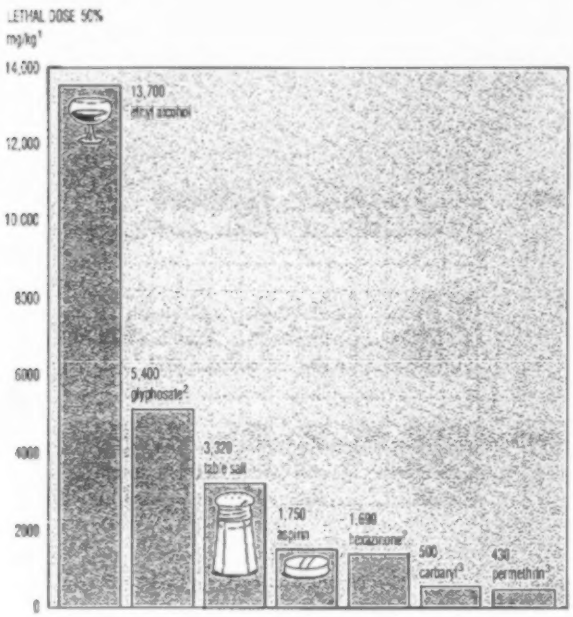


3.8 Relative Toxicity of Some Pesticides Used in B.C. Forestry Compared to Other Common Chemicals

3.9 Period of Exposure Risk After a Pesticide Treatment



3.8 Relative Toxicity of Some Pesticides Used in B.C. Forestry Compared to Other Common Chemicals



[1]Lethal Dose (LD 50%) is a comparative measure of acute toxicity. It measures the amount of chemical in milligrams per kilogram of animal body weight required to statistically kill 50% of the animals tested. All chemicals are capable of killing any animal at some dosage rate. The smaller dosage rate to kill an animal, the higher the acute toxicity of the chemical.

[2]Herbicide

[3]Insecticide

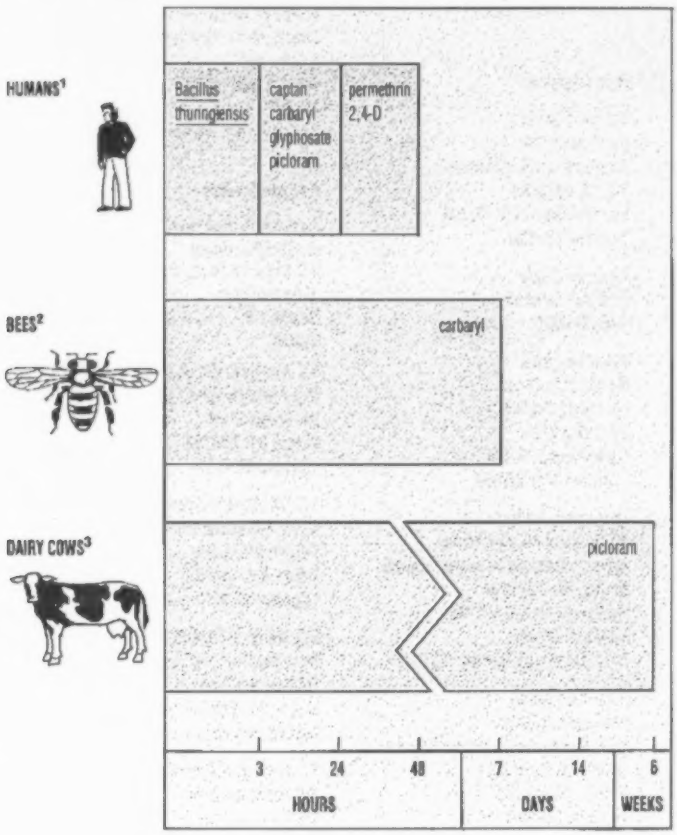
Sources

Worthing, C.R. (editor), 1979. The Pesticide Manual: A World Compendium. 6th Edition, British Crop Protection Council, Croydon.

Miller, A.V. and S.M. Craig (editors), 1972. Handbook for Pesticide Applicators and Pesticide Dispensers. Pesticide Control Branch, Ministry of Environment, Victoria.

Ghassemi, M., L. Fargo, et al. 1981. Environmental Fates and Impacts of Major Forest Use Pesticides. EPA Contract No. 68-02-3174. U.S. Environmental Protection Agency, Washington, D.C.

3.9 Period of Exposure Risk After a Pesticide Treatment



[1]These time periods should elapse before workers are allowed to re-enter the treated area without protection. The recommendation for B.t. was determined by BCFS. All other recommendations come from Standard Practices for Pesticide Applicators. 1985, Workers Compensation Board.

4.1 List of Authorities and Organizations Involved with Forest Pesticides

Federal Agencies

Agriculture Canada
B.C. Regional Office
Plant Health and Plant Products
315 - 80 - 6th Street
New Westminster, B.C. V3L 5B3
Telephone: 666-0593

Agriculture Canada
Pesticide Toll-Free Line
1-800-267-6315

Agriculture Canada
Pesticides Directorate
K.W. Neatby Building
960 Carling Avenue
Ottawa, Ontario K1A 0C6
Telephone: (613) 993-4544

Environment Canada
Environmental Protection Service
Aquatic Program and Contaminants Control
Kapilano 100, Park Royal
West Vancouver, B.C. V7T 1A2
Telephone: 666-6711
Oil or chemical spill reporting: 666-6100

Environment Canada
Pacific Forestry Centre
Forest Renewal and Environment Research
506 West Burnside Road
Victoria, B.C. V8Z 1M5
Telephone: 388-0600

Fisheries and Oceans Canada
Water Quality Unit
Habitat Management Division
1090 West Pender Street
Vancouver, B.C. V6E 2P1
Telephone: 666-6566

Forest Pest Management Institute
Department of Environment
P.O. Box 490
Sault Ste. Marie, Ontario
P6Z 5M7
Telephone: (705) 949-9461

Provincial Agencies

Forest Pest Review Committee
c/o Silviculture Branch
B.C. Ministry of Forests and Lands
31 Bastion Square
Victoria, B.C.
V8W 3E7

B.C. Ministry of Agriculture and Fisheries
Crop Protection Branch
808 Douglas Street
Victoria, B.C. V8W 2Z7
Telephone: 387-5121

B.C. Ministry of Environment and Parks
Aquatic Studies Branch
765 Broughton Street
Victoria, B.C. V8W 1E2
Telephone: 387-9500

B.C. Ministry of Environment and Parks
Recreational Fisheries Branch
780 Blanshard Street
Victoria, B.C. V8W 2H1
Telephone: 387-4573

B.C. Ministry of Environment and Parks
Pesticide Control Branch
810 Blanshard Street
Victoria, B.C. V8W 3E1
Telephone: 387-9411

B.C. Ministry of Environment and Parks
Spills – Dangerous Goods
Call Operator (No Charge)
Zenith 2567

B.C. Ministry of Environment and Parks
Wildlife Branch
780 Blanshard Street
Victoria, B.C. V8V 1X4
Telephone: 387-9717

B.C. Ministry of Forests and Lands
Protection Branch
31 Bastion Square
Victoria, B.C. V8W 3E7
Telephone: 387-5965

B.C. Ministry of Forests and Lands
Silviculture Branch
31 Bastion Square
Victoria, B.C. V8W 3E7
Telephone: 387-1191

B.C. Ministry of Health
Division of Occupational Health
828 West 10th Avenue
Vancouver, B.C. V6J 4M3
Telephone: 660-6135

Workers' Compensation Board of B.C.
Occupational Hygiene Department
Pesticide Information Response System
6951 Westminster Highway
Richmond, B.C. V7C 1C6
Telephone: 273-2226

Forestry Associations

Assn. of British Columbia Professional Foresters
510 - 744 W. Hastings Street
Vancouver, B.C. V6C 1A5
Telephone: 687-8027

British Columbia Forestry Association
410 - 1200 W. Pender Street
Vancouver, B.C. V6E 2S9
Telephone: 683-7591

Canadian Pulp & Paper Association
Sun Life Building, 23rd Floor
1155 Metcalfe Street
Montreal, Quebec
H3B 2X9
Telephone: (514) 866-6521

Silviculture Committees
c/o Silviculture Branch
B.C. Ministry of Forests and Lands
31 Bastion Square
Victoria, B.C. V8W 3E7
Telephone: 387-1191

Council of Forest Industries of British Columbia
1500 - 1055 West Hastings St.
Vancouver, B.C. V6E 2H1
Telephone: 684-0211

Universities, Colleges and Technical Schools

Selkirk College
Department of Forest Technology
Box 1200
Castlegar, B.C. V1N 3J1

College of New Caledonia
Forest Resource Technology
3330 - 22nd Avenue
Prince George, B.C.
V2N 1P8

Malaspina College
Department of Forest Technology
900 - 5th Street
Nanaimo, B.C. V9R 5S5

B.C. Institute of Technology
Department of Forest Technology
3700 Wellingdon Avenue
Burnaby, B.C. V5H 3H2
Telephone: 434-5734

Simon Fraser University
Biological Sciences Dept.
Pest Management Program
Burnaby, B.C. V5A 1S6
Telephone: 291-3705

University of British Columbia
Faculty of Forestry
191 - 2357 Main Mall
Vancouver, B.C. V6T 1W5
Telephone: 228-2727

4.2 Forest Pesticide References

The following publications are available from British Columbia Ministry of Forests and Lands libraries and information centres, located in regional and district offices. More extensive bibliographies are also available from Ministry information centres.

Environmental Aspects

Fletcher, K. and B. Freedman. 1985. Effects of the herbicides Glyphosate, 2,4,5-trichlorophenoxyacetic and 2,4-dichlorophenoxyacetic acid on forest litter decomposition. Can. J. For. Res. 16(1): 6-9.

Ghassemi, M. 1981. Environmental fates and impacts of major forest use pesticides. U.S. Environmental Protection Agency, Washington, D.C. 476 p.

Neary, D.G., P.B. Bush, and M.A. Grant. 1986. Water quality of epheneral forest streams after site preparation with the herbicide Hexazinone. For. Ecol. Manage. 14: 23-40.

Norris, L.A. 1986. Behaviour of chemicals in the forest environment. Oregon State Univ., Corvallis, Or.

Newton, M., K.M. Howard, B.R. Kalpsas, R. Danhause, C.M. Lottman, and S. Dubelman. 1984. Fate of glyphosate in an Oregon forest ecosystem. J. Agric. Food Chem. 32: 1144-1151.

U.S. Department of Agriculture Forest Service Pacific Northwest Region. 1987. Western spruce budworm management in Oregon and Washington during 1986. Environmental Assessment. 79 p. In press.

Wan, M.T.K. 1986. Persistence of Glyphosate and its metabolite amino-methylphosphonic acid in some coastal British Columbia streams. Can. Env. Prot. Serv., Pacific and Yukon Region, Vancouver, B.C. Regional Program Rep. 85-01. 18 p.

U.S. Department of Agriculture Forest Service. 1984. Pesticides background statements: V.1. Herbicides. Handb. No. 633. 1100 p.

Human Health

Hatcher, J.D. (Chairman), 1984. Task force on chemicals in the environment and human reproductive problems in New Brunswick: Executive Summary. Dalhousie University, Faculty of Medicine, Halifax, N.S. 5 p.

Inverness-Victoria Medical Society. 1983. Health effects of herbicides 2,4-D and 2,4,5-T. Nova Scotia Forestry Commission, Halifax, N.S. 42 p.

National Research Council. 1983. 2,4-D: Some current issues. Ottawa, N.R.C.C. No. 20647. 99 p.

Spitzer, W.O. 1984. Conclusions and Recommendations. In final reports of the New Brunswick task force on the environment and cancer. N.B. Dep. of Health, Fredericton, N.B. Chap. 5, pp. 137-140.

Walstad, J.D. and F.N. Dost. 1984. The health risk of herbicides in forestry: a review of the scientific record. Oregon State University. Special Publication No. 10. 60 p.

Workers' Compensation Board of B.C. 1985. Standard practices for pesticide applicators. Vancouver, B.C. 140 p.

U.S. Department of Agriculture Forest Service. 1984. Pesticides background statements: V.1. Herbicides. Handb. No. 633. 1100 p.

Witt, Jim (editor). 1985. Chemistry, biochemistry and toxicology of pesticides. Proc. of Oregon State Univ. Extension Serv. Shortcourse. Eugene, Oregon. 118 p.

Legislation/Policy

British Columbia. 1986. Pesticide Control Act regulation. Consolidated July 31, 1984. Queen's Printer, Victoria, B.C. B.C. Reg. 319/81. 19 p.

_____. 1986 Pesticide Control Act. Consolidated October 15, 1982. Queen's Printer, Victoria, B.C. R.S. Chap. 322. 7 p.

British Columbia Ministry of Forests. 1985. Ministry policy: forest and range pest management: pesticide regulations and use. Victoria, B.C. 11 p.

Canada Environmental Protection Service. 1984. Pesticide use and control in Canada. Ottawa, Ont. 71 p.

Public Debate

Canadian Pulp and Paper Association. 1985. Proceedings of the Public Affairs and Forest Management Pesticides in Forestry Seminar, Toronto. 71 p.

Kennedy, D., P. Willis, and C. Young. 1982. The great herbicide debate. Forestalk 6(3): 22-27.

Technical Facts/General

Canadian Pulp and Paper Association. 1986. Pesticides: technical references kit. Montreal.

Dolinar, L.H. and J.H. Borden. 1984. Pesterms: a glossary of forest pest management terms. Pest Management Report No. 3 B.C. Ministry of Forests, Victoria, B.C. 34 p.

Henigman, J.F. and J.D. Beardsley. 1985. Forest pesticide handbook of British Columbia. Council of forest industries of British Columbia, and Province of British Columbia Ministry of Forests and Lands. Volumes 1-7. Victoria, B.C.

Malik, N. and W.H. Vanden Born. 1986. Use of herbicides in forest management. Northern Forestry Centre. Canadian Forestry Service Information Report. NOR - X - 282 Edmonton, Alberta 18 p.

4.3 District/Regional Information

PESTICIDE USE PROJECTS

YEAR: _____ PROJECT NO.: _____

LOCATION: _____

PESTICIDE(S): _____

PURPOSE OF TREATMENT: _____

METHOD OF TREATMENT: _____

AREA (ha) APPLIED FOR: _____ TREATED: _____

YEAR: _____ PROJECT NO.: _____

LOCATION: _____

PESTICIDE(S): _____

PURPOSE OF TREATMENT: _____

METHOD OF TREATMENT: _____

AREA (ha) APPLIED FOR: _____ TREATED: _____

YEAR: _____ PROJECT NO.: _____

LOCATION: _____

PESTICIDE(S): _____

PURPOSE OF TREATMENT: _____

METHOD OF TREATMENT: _____

AREA (ha) APPLIED FOR: _____ TREATED: _____

YEAR: _____ PROJECT NO.: _____

LOCATION: _____

PESTICIDE(S): _____

PURPOSE OF TREATMENT: _____

METHOD OF TREATMENT: _____

AREA (ha) APPLIED FOR: _____ TREATED: _____

4.3 District/Regional Information

PESTICIDE USE PROJECTS

YEAR: _____ PROJECT NO.: _____

LOCATION: _____

PESTICIDE(S): _____

PURPOSE OF TREATMENT: _____

METHOD OF TREATMENT: _____

AREA (ha) APPLIED FOR: _____ TREATED: _____

YEAR: _____ PROJECT NO.: _____

LOCATION: _____

PESTICIDE(S): _____

PURPOSE OF TREATMENT: _____

METHOD OF TREATMENT: _____

AREA (ha) APPLIED FOR: _____ TREATED: _____

YEAR: _____ PROJECT NO.: _____

LOCATION: _____

PESTICIDE(S): _____

PURPOSE OF TREATMENT: _____

METHOD OF TREATMENT: _____

AREA (ha) APPLIED FOR: _____ TREATED: _____

YEAR: _____ PROJECT NO.: _____

LOCATION: _____

PESTICIDE(S): _____

PURPOSE OF TREATMENT: _____

METHOD OF TREATMENT: _____

AREA (ha) APPLIED FOR: _____ TREATED: _____